DOI:
10.1111/add.13803

Document Version
Peer reviewed version

High risk of overdose death following release from prison: Variations in mortality during a 15-year observation period

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Word count: 3418

Competing interests:

The authors do not have competing interests that may in any way gain or lose from the research described in our original study.

Abstract

Background and Aims: The time post-release from prison involves elevated mortality, especially overdose deaths. Variations in overdose mortality both by time since release from prison and time of release has not been sufficiently investigated. Our aims were to estimate and compare overdose death rates at time intervals after prison release and to estimate the effect on overdose death rates over calendar time.

Design, Setting, Participants, Measurements: This 15-year cohort study includes all persons (n= 91,090) released from prison (01.01.2000 to 31.12.2014) obtained from the Norwegian prison registry, linked to the Norwegian Cause of Death Registry (2000-2014). All-cause and cause-specific mortality were examined during different time-periods following release: first week, second week, 3-4 weeks and 2-6 months, and by three different time intervals of release. We calculated crude mortality rates (CMRs) per 1000 PY and estimated incidence rate ratios (IRR) by Poisson regression analysis adjusting for time intervals after prison release, release periods and time spent in prison.

Findings: Overdose deaths accounted for 85% (n=123) of all deaths during the first week following release (n=145), with a peak during the two days immediately following release. Compared with week 1, the risk of overdose death was more than halved during week 2 (IRR 0.43; 95% CI, 0.31-0.59) and reduced to one-fifth in weeks 3-4 (IRR 0.22; 95% CI, 0.16-0.31). The risk of overdose mortality during the first 6 months post-release was almost twofold higher in 2000-2004 compared with 2005-2009 (IRR 0.53; 95% CI, 0.43-0.65) and 2010-2014 (IRR 0.47; 95% CI, 0.37-0.59). The risk of overdose death was highest for those incarcerated for 3-12 months compared with those who were incarcerated for shorter or longer periods, and recidivism was associated with risk of overdose death.

Conclusions: There is an elevated risk of death from drug overdose among people released from Norwegian prisons, peaking in the first week. The risk has reduced since 2000-2004 but is greatest for those serving 3-12 months compared with shorter or longer periods.

Background

The ongoing overdose epidemic is a global public health crisis (1, 2). Criminal justice populations are no exception, as they are typically drug-involved (3) and high mortality rates in people released from prison have been documented in several countries (4-7), with accidental drug overdose as the leading cause of death (8, 9).

The concentration of overdose deaths within the early post-release period, compared to later time periods, has been consistently observed for more than a decade (6, 9-15). A meta-analysis, conducted by Merrall et al, of six studies (69,093 person-years and 1,033 deaths) identified a three- to eight-fold increased risk of drug-related death when comparing weeks 1 + 2 with week 3–12 (11).

Most studies investigating overdose mortality following prison release are based on large-scale registry data; necessary in order to study rare outcomes (overdose mortality) within narrow time frames (days and weeks following release). However, there are major challenges for such mortality studies (16). The study of rare events, such as overdose deaths in a narrow period post-release, requires access to, and analysis of, data-sets large enough to detect change over time. There are generally two main approaches; either to obtain data from the same setting over a long time-span (14, 15, 17), or the integration of data of a variety of study settings and differences in methodology (pooled data and meta-analysis) (11, 13). The two approaches both have merit but also both have inherent limitations. The inclusion of data over a long time-period needs to take into account temporal changes during the observation period and produce more than one single estimate. On the other hand, pooled datasets need to take into account the differing drug-use patterns and treatment practices in order to make meaningful interpretations. For example, in the case of the Merrall et al. meta-analysis (11), only six of the identified 18 studies were suitable for inclusion, due to heterogeneity in setting, analysis and reporting, which inevitably limits the generalizability of the findings.

Opioids are often involved in fatal cases of overdoses (2). However, the proportion of prisoners having a history of opioid use vary across countries (18), and may vary over time (19). Only a few studies have included time trends in the analysis (15, 17, 20, 21), and so variations across time and setting in post-release mortality have not been sufficiently investigated.

Using this background, we have analysed Norwegian national deaths data following prison release over a 15-year period, investigating risk periods (first week, second week, 3-4 weeks and 2-6 months) over three quinquennia (2000-2004, 2005-2009, 2010-2014).

We aimed to address three main questions; first, estimate and compare overdose death rates at time intervals after prison release; second, to examine changes in patterns of overdose death rates over calendar time; and third, identify risk factors for overdose death.

Methods

Design

This prospective cohort study comprises 105,903 individuals in the Norwegian Prison Registry, contributing 168,772 releases from Norwegian prisons over 15 years (1 January2000-31 December.2014). Through personal identification numbers, these were linked to data from the Norwegian cause of death registry (1.January 2000-31 December.2014).

Setting

Norway has low rates of imprisonment and high levels of health care including drug treatment, aiming at rehabilitation. With a national population of 5.2million, Norway has a prison population of 3,700 and a prison population rate was 75/100,000 in 2014 (22).

Data sources

The Prison Registry serves administrative and statistical purposes, and includes personal data on all persons imprisoned in Norway, including age, gender, convictions and sentences (23). The registry captures date of admission and date of release, both for sentences served and time spent on remand. This includes a code describing the release circumstances, which differentiates between "false releases" (transfers to hospitals, rehabilitation institutions, deaths in prison) and actual prison release.

The Norwegian Death Registry includes complete death certificates reported by medical doctors after examination of the deceased Death certificates are collected by the Death Registry at the Norwegian Institute of Public Health which codes multiple ICD-10 causes of death (24). The Causes of death registry include information about the underlying cause of death (the disease or injury which initiated the train of morbid events leading directly to death) and immediate causes of death (the terminal event or complication present at the moment of death) (25). Information about where the person was found dead and the actual date of death. The coverage and the completeness of the Norwegian Death Registry is high; it comprises all residents and include medical information on more than 98% of all deaths (25).

Measures

Of the original 105,903 former inmates, we excluded 13,240. The majority of those excluded (12,793) did not have a valid Norwegian identification number and were mostly foreign inmates. Inmates were also excluded in cases of: date of death prior to release date, deaths in prison or other institutions, and cases where re-entry to prison was coded before the persons release date (n= 477.The remaining sample comprised 92,633 former prisoners released 153,604 times (Table 1).

We especially focussed on mortality within 6 months following release, therefore data on all former prisoners were right censored at 6 months. Further 3,514 were excluded as they were released in the latter half of 2014 and thus had less than 6 months of follow-up data available. The final sample comprised 91,090 former prisoners, released 150,090 times.

The time at risk was defined as: the period between release from prison and death (censored at 6 months), from release to another incarceration (censored at 6 months) or from release throughout 6 months. As the same participant may contribute to multiple six-month observation periods and at risk after every release, all release-periods are included in the analysis. The time at risk only include time outside prison: both for persons with one or repeated incarcerations in the study period, all the time incarcerated was excluded.

Using only the underlying ICD-10 codes of death (24), we categorized causes of death into five mutually exclusive categories: 'Overdose deaths' (F11- F16, F19, F55, X40- X44, X60-X64, X85, Y10-Y14), 'accidents' (V01-V99, W00-W19, W20-W99, X31, X00-X09, X58-X59), 'suicide' (X65- X84, Y87.0) and 'cardiovascular disease/cancer' (C00-C97, I00-I99, G45, G46). All other deaths were categorized as 'other deaths'.

Ethics

The study was approved by the regional Ethics Committee and the Norwegian Correctional Directorate. Data linkage was performed by the Norwegian Institute of Public Health who used anonyms to conduct the analyses.

Statistical analysis

Statistical analyses were performed using Stata (v.14). Descriptive statistics were available for all individuals released from prison who died post-release, and were categorized according to ICD codes. Former inmates whose date of death was the date of release were defined to have died on day 1 (none of these died in prison).

As the number of releases declined annually, weighted mortality rates were calculated to estimate mortality per year of release. Weighted mortality rates were defined as the number of deaths by year of release was divided by number of releases per year and multiplied by 100 (Table 1).

Crude mortality rates (CMRs) and 95% confidence intervals (26) were calculated as number of deaths per 1000 person years (PY) In order to compare crude mortality rates (CMR), rate ratios (RR) and 95% confidence intervals (27) were examined, with calculation of the ratio between two rates (if there is no difference between two rates, the rate ratio is equal to one).

Factors associated with overdose death during six months post release were estimated using Poisson regression model. The coefficients were interpreted in terms of incidence rate ratios (IRR) with 95% confidence intervals. We ran univariate models for all covariates and one multivariate model including all covariates.

Role of the funding source

The funder of the study had no role in study design, data collection, data analysis, data interpretation, or writing of the report. The corresponding lead author had full access to all the data in the study and had final responsibility for the decision to submit for publication

Findings

A total of 92, 633 persons were released 153,604 times from prison during the 2000-2014 study period. The number of annual releases decreased progressively, markedly from 2009/2010 onwards (see Table 1). Over the 15-year period, men comprised more than 90% of all releases (Table 1). Annual deaths based on the number of releases the given year, decreased through the 15-year period: in 2000 the weighted mortality rate was 0.84 compared to 0.52 in 2005, 0.43 in 2010 and 0.65 in 2014. Overall, men accounted for more than 90% of deaths, annually increasing over the 15-year period (Table 1).

- INSERT TABLE 1

During 6 months post-release, the overall all-cause mortality rate was 1245/100,000 person-years and the overdose mortality rate was 696/100,000 person-years. During the first week post-release, overdose deaths accounted for 85% of all deaths, with accidents accounting for 6 and suicide for 3% (Table 2). Overdose deaths peaked during the first days post-release, and thereafter gradually declined during the first month post-release (Figure 1).

- INSERT FIGURE 1

During the second week post-release, the total number of deaths approximately halved (versus first week), with overdose deaths accounting for 68% of all deaths. During week 3-4, and month 2-6, overdose death accounted for 62% and 46% of all deaths, respectively. We observed this pattern during all release-periods (Supplementary Table). A similar pattern was seen with deaths from accidents, but not to the same extent (Table 2).

- INSERT TABLE 2

The rate of overdose deaths during the first week post-release was higher during the 2000-2004 quinquennium, compared to 2005-2009 and 2010-2014 (Table 3). The same differences in overdose deaths according to release-patterns was also found in week 2, but was less prominent in week 2-3 and month 2-6 (Table 3).

- INSERT TABLE 3

The adjusted Poisson regression model showed that, compared to the first week, the incident rate for overdose death was approximately 60% lower during week 2, almost 80% lower during week 3-4, and almost 90% lower during month 2-6 (Table 4).

- INSERT TABLE 4

Compared to those released during 2000-2004, those released in the period of 2005-2009 and 2010-2014 had respectively 47% and 53% reduced risk of overdose death during the first six months post-release (Table 4).

Women had increased risk of overdose death during the first six months post-release. Duration of incarceration had an inverted U-curve association with risk of overdose death: compared to being incarcerated for one month or less, the risk of overdose death was highest for those incarcerated for 3-12 months. Higher number of incarcerations was associated with elevated risk of overdose death post-release (Table 4).

We also ran Poisson-regression models to calculate the potential effect of month of release (January-December), and day of release (Monday-Friday) on overdose mortality during the first week post-release. Neither release month nor release day was associated with overdose mortality (data not shown).

Discussion

The very first days post-release have a greatly increased overdose death rate for released prisoners, with the rate of overdose deaths during the first week almost 60% higher compared to the second week, and almost 90% higher than the rate during the 2-6 months following release. During the first week post-release, overdoses accounted for about 85% of all deaths, and the proportion of deaths

from overdose versus other causes remained high throughout the 6-month study period. Reductions in death risk were found over calendar time, with the higher rates of overdose death occurring in the early study period.

The extremely high overdose mortality rate during the first weeks post-release accords with findings reported elsewhere (10, 14). A particularly intense peak in overdose mortality was evident during the first few days following release, which supports the finding of Degenhardt et al. (14) and Groot et al.(28), although more replication studies with large prison release cohorts are still required. Nevertheless not all studies observe the high level of overdoses after release, with a Swedish registry-based study finding no such peak during the first weeks post-release (4). Such differences in post-release risk observed from varied settings may derive from different national drug use patterns, e.g. dominated by amphetamine in the Swedish prison population.

More than 50% of all deaths during the six months following release were overdose deaths – a finding similar to some studies (29), but higher than others such as Binswanger and colleagues (10) and Håkansson and colleagues (4) who found about a quarter of deaths of released prisoners to be related to drug overdose. The high proportion of overdoses in the immediate period following incarceration might reflect prison settings where released inmates typically have a history of heroin or opioid use, and maybe also particularly high in settings where poly-drug injection is the common mode of administration, as in the current setting. For several years, Norway has been ranked as one of the European countries with the highest rates of overdose mortality, often explained by high rates of injection drug use and an ageing poly-drug-using population (30-32). Overall this means that drug use patterns both in terms of substances consumed as well as mode of administration will be reflected in mortality both in the general populations as well as in prison-release populations.

Substantial changes over the 15-year period were identified in our study, with the higher rates of overdose death occurring with those released in the 2000-2004 quinquennium, with lower mortality rates amongst those released in later eras. This finding is similar to other studies conducted in Australia and Scotland, finding a decrease in the SMR related to overdose death over time (14, 15, 17, 21).

There might be several explanations for the observed fall in overdose death over time. The reduction in overdose mortality post-prison parallels the reduction observed in national overdose mortality data and changes over time with, a 40% reduction in drug overdose deaths from 2000 to 2005, followed by more stable annual national overdose mortality rate. For Norway, the reduced risk of overdose across time is likely due to increasing numbers of patients enrolled in the national opioid maintenance programme, with gradually the same access to treatment for prison inmates as those

outside prisons, introduced progressively in Norway from 1998 onwards. In Norway, the number of patients in opioid maintenance treatment has increased from 2000 in 2002 to 7000 in 2014 (33, 34). At the same time, there have been parallel increases in the number of maintenance patients entering the correctional system, annually estimated to about 10% of the patient population (33, 35, 36).

A few studies have investigated the impact of prison based opioid maintenance treatment on drug related death: in a large cohort study of 16,453 released from prison in New South Wales, Australia, Degenhardt and colleagues found that opioid maintenance treatment provided in prison and post-release independently reduced mortality in the immediate post-release period (14). Further, in a cohort study including all Scottish prisons, Bird and colleagues found a reduction in the number of drug-related deaths 12 weeks after prison release during the period 1996-2007. Contribution of methadone treatment in the outside community was formulated as a likely explanation of the observed reduction.

An alternative explanation for the reductions in overdose death is that the proportion of opioid-dependent prisoners decreased over the observation period. A decrease in the opioid-dependent population entering prisons may be a consequence of the national introduction of opioid maintenance treatment, as patients enrolled in OMT are less likely to engage in criminal activity (37), and consequently less likely to be sent to prison. It could also be a consequence that patterns of drug use in the community may shift over time with a smaller proportion of people entering prison having a history of opioid use, irrespective of community opioid maintenance treatment. In Australia, there has been a marked transition from opioid to methamphetamine use among prison entrants (19) and the same trend could possibly also be found elsewhere Norway has developed advanced registry databases for the purposes of official statistics and research (38). The registers are high quality, nationwide, continuously updated and have negligible or controllable attrition. Our study includes a nationwide population of releases with unique identifiers for each individual linked with all deaths obtained from a national cause of death registry. The complete national coverage of the prison registry means that our results are generalizable to the Norwegian prison population as well as to settings where opioid injection is a general characteristic among drug users and prison inmates.

Our study is among the larger studies of prisoner mortality internationally. Due to the high number of deaths captured during the first weeks post-release, we were able to describe all mortality cases based on absolute numbers as well as by statistical estimations.

However, data linkage methods have limitations, including limited demographic and sociocultural variables. In our study, linkage was only available for individuals provided with Norwegian personal identification numbers, and hence we were not able to follow foreign inmates who did not have a

Norwegian identifier. Further, the study cannot distinguish between death rates in drug users released versus other persons released from prison. Moreover, age was only included as a separate variable for those deceased, and we were thus not able to conduct age adjusted analysis.

Misclassifications of causes of death may occur in all registry data: it may be that some intentional suicides might be classified as overdose death, causing overestimation of overdose as a cause of death. Conversely, unattended and accident coded deaths may include some misclassified overdose deaths, leading to underestimating the total number of overdose deaths. However, completeness of the Norwegian Death Registry is high as it include medical information on more than 98% of all deaths (25).

Our study has investigated a large sample from one national setting, and our results advance more precise day-by-day understanding of risk of overdose death following prison release. The greater precision about the most critical time-period following release (i.e. to the first few days has) important clinical implications. According to WHO recommendations, comprehensive provision of health care services is necessary throughout both the period in prison and during subsequent community reintegration (39). Most importantly, interventions need to be planned in advance and implemented prior to release, in order to address the known high risk of overdose death. Drug dependent persons released from prison are doubly-vulnerable during the critical transition to civil society. Therefore, collaboration between correctional services, drug treatment services and social services needs to facilitate as safe release from prison as possible. The practice of continuing approved and effective treatment, such as opioid maintenance treatment (40) as well as provision of naloxone (41) alongside wider harm reduction and social re-integration support in correctional settings is essential in reducing overdose deaths post-release among former inmates.

Contributors

AB and MRS did the literature search. AB, MRS, AT SS, JS and TC contributed to the study design and conceptualisation. AB, MRS and AT had full access to and analysed the data. AB, MRS, AT SS, JS and TC interpreted the data. AB, MRS, AT SS, JS and TC have final responsibility for the submission.

Acknowledgements

We thank the data owners at the Norwegian Institute of Public Health and the Directorate of Correctional services of Norway for helpful correspondence with regard to extracting data from the Norwegian Prison Registry and the Norwegian cause of death registry.

Table 1. Number of releases per year of observation and annual death rates per calendar year of release (n=92 633).

Year	Releases (N	Men (%)	Deaths (n)	Age (mean)	Men (%)	Deaths per release [a]
2000	10398	92 %	87	33	91 %	0.84
2001	11357	91 %	94	33	86 %	0.83
2002	11161	92 %	72	34	90 %	0.65
2003	10709	92 %	51	38	86 %	0.48
2004	10463	93 %	61	36	93 %	0.58
2005	11255	92 %	58	39	93 %	0.52
2006	11386	92 %	57	33	93 %	0.50
2007	11819	91 %	58	38	97 %	0.49
2008	11616	91 %	66	39	92 %	0.57
2009	10277	90 %	47	42	94 %	0.46
2010	9796	91 %	42	43	91 %	0.43
2011	9160	92 %	54	39	93 %	0.59
2012	8661	90 %	47	40	98 %	0.54
2013	8129	91 %	35	40	97 %	0.43
2014[b]	7417	92 %	48	40	98 %	0.65

[a] N/n*100. [b] All releases and all deaths during 2014 are included

Table 2. All cause and cause-specific mortality rates during different time-periods following release (n=91 090). Crude Mortality Rates (CMR) per 1000 PY and 95% CI

	First week		Second week		Week 3-4		Month 2-6		Total 1-6 months	
	n	**CMR (95% CI)**	**n**	**CMR (95% CI)**	**n**	**CMR (95% CI)**	**n**	**CMR (95% CI)**	**n**	**CMR (95% CI)**
Overdose deaths	123	42,9 (35,5-50,3)	52	18,2 (13,4-23,1)	50	8,8 (6,4-11,2)	268	4,5 (3,9-5,1)	493	7,0 (6,3-7,6)
Accidents	9	3,1 (1,1-5,1)	7	2,5 (0,7-4,2)	4	0,7 (0,0-1,4)	82	1,4 (1,1-1,7)	102	1,4 (1,1-1,7)
Suicide	4	1,4 (0,1-2,7)	5	1,8 (0,3-3,3)	11	1,9 (0,8-3,1)	54	0,9 (0,6-1,2)	74	1,0 (0,8-1,3)
Cancer/cardiovascular	3	1,0 (-0,1-2,2)	6	2,1 (0,5-3,7)	7	1,2 (0,3-2,1)	61	1,0 (0,7-1,3)	77	1,1 (0,8-1,3)
Other	6	2,1 (0,5-3,7)	7	2,5 (0,7-4,2)	9	1,6 (0,6-2,6)	114	1,9 (1,5-2,3)	136	1,9 (1,6-2,3)
All causes	145	50,5 (42,5-58,6)	77	27,0 (21,1-32,9)	81	14,3 (11,3-17,4)	579	9,7 (8,9-10,6)	882	12,5 (11,6-13,3)

Table 3. Overdose death at different time-periods and release periods (n=91 090). Crude Mortality Rates (CMR) per 1000 PY and 95% CI.

	First week		**Second week**		**Week 3-4**		**Month 2-6**		**Month 1-6**	
	CMR (95% CI)	**n**	CMR (95% CI)	n	CMR (95% CI)	n	CMR (95% CI)	n	CMR (95% CI)	n
Overdose deaths 2000-2014	42,85 (35,90-51,13)	123	18,23 (13,89-23,93)	52	8,83 (6,69-11,65)	50	4,51 (3,10-5,08)	268	6,96 (6,37-7,60)	493
Released 2000-2004	69,66 (55,29-87,76)	72	25,35 (17,26-37,24)	26	10,82 (7,13-16,44)	22	5,48 (4,57-6,58)	116	9,35 (8,23-10,62)	236
Released 2005-2009	30,60 (21,76-43,05)	33	15,85 (9,85-25,49)	17	6,57 (3,89-11,09)	14	3,73 (3,01-4,62))	84	5,53 (4,70-6,49)	148
Released 2010-2014	23,73 (14,95-37,67)	18	11,94 (6,21-22,94)	9	9,35 (5,54-15,79)	14	4,30 (3,93-5,45)	68	5,79 (4,80-6,99)	109

Table 4. Overdose deaths by gender, time following release, release periods and time spent in prison (n=91 090). Poisson regression and 95% CI.

	IRR (95% CI)	P-value
Release periods		
2000-2004 (reference)		
2005-2009	0,53 (0,43-0,65)	P<0,001
2010-2014	0,47 (0,37-0,59)	P<0,001
Time following release		
First week (reference)		
Second week	0,43 (0,31-0,59)	P<0,001
3-4 weeks	0,22 (0,16-0,31)	P<0,001
2-6 months	0,12 (0,10-0,15)	P<0,001
Time spent in prison		
Up to 1 month (reference)		
1-3 months	1.45 (1,15-1,83)	0,002
3-12 months	2.79 (2,23-3,51)	P<0,001
1- 2 years	1,79 (1,13-2,83)	0,014
More than 2 years	0,67 (0,25-1,80)	0,422
Former imprisonments	1,31 (1,10-1,16)	P<0,001
Gender		
Men (reference)		
Women	1,42 (1,06-1,91)	0,020

RR: Incidence rate ratio (estimated rate ratio for a one unit increase of change in the explanatory variable given the other variables held constant in the model).

Supplementary Table. Overdose deaths following release, stratified by release periods (n=91 090). Poisson regression and 95% CI. All strata adjusted by gender, duration of imprisonment, and number of former imprisonment.

	Total period of observation		Released 2000-2004		Released 2005-2009		Released 2010-2014	
	IRR (95% CI)	P-value	IRR (95% CI)	P-value	IRR (95% CI)	P-value	IRR (95% CI)	P-value
Time following release								
First week (reference)								
Second week	0,43 (0,31-0,59)	P<0,001	0,37 (0,23-0,57)	P<0,001	0,52 (0,29-0,94)	0,029	0,51 (0,23-1,31)	0,098
3-4 weeks	0,22 (0,16-0,31)	P<0,001	0,17 (0,10-0,26)	P<0,001	0,23 (0,12-0,44)	P<0,001	0,43 (0,21-0,86)	0,017
2-6 months	0,12 (0,10-0,15)	P<0,001	0,09 (0,07-0,12)	P<0,001	0,15 (0,10-0,22)	P<0,001	0,22 (0,13-0,36)	P<0,001

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